7. Routine Ground Water Monitoring

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Introduction

To complement extensive Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) monitoring activities associated with known areas of ground water contamination, LLNL routinely monitors additional ground water wells in the Livermore Valley and at the Experimental Test Site (Site 300) in the Altamont Hills. Routine ground water monitoring consists of surveillance monitoring and compliance monitoring. Areawide surveillance monitoring is directed by DOE Orders 5400.1 and 5400.5. Additionally, DOE provides direction on radiological effluent monitoring in *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (U.S. Department of Energy 1991). LLNL determines the number and locations of sampling wells, the constituents to be monitored, and the frequency of sampling for surveillance monitoring purposes. This allows LLNL to devise a comprehensive, cost-effective monitoring program.

Fewer compliance ground water monitoring options are available to LLNL. Compliance monitoring requirements at Site 300 are specifically prescribed in Waste Discharge Requirement (WDR) permits issued by the Central Valley Regional Water Quality Control Board (RWQCB). The WDRs specify the wells to be monitored, the constituents to be measured, the frequency of measurement for each constituent, and the frequency and form of required reports. The Site 300 ground water compliance monitoring data that are summarized in this chapter were previously submitted to the Central Valley RWQCB and other interested federal agencies in four quarterly reports and one annual report (Christofferson et al. 1994a, 1994b, 1994c, 1995a, and 1995b).

LLNL routinely measures tritium in ground water throughout the Livermore Valley and at Site 300. Ground waters are sampled from water-supply wells and from wells that are used only for monitoring purposes. Additional potential contaminants to ground water are monitored at Site 300, where compliance monitoring is associated with two landfills, Pits 1 and 7, closed under the Resource Conservation and Recovery Act (RCRA), and with two connected surface impoundments, where process water is allowed to evaporate. The primary objective of compliance monitoring at Site 300 is the earliest possible detection of any release of contaminants to the ground water from the closed landfills and the process water impoundments. Compliance monitoring is accomplished by measuring specified constituents of concern and general contaminant indicator parameters. The sampled ground waters come from specific networks of wells upgradient and downgradient from the landfills and the process-water impoundments. Additionally, leachate collection systems beneath the process water impoundments are inspected weekly for the presence of water.

7. Routine Ground Water Monitoring

Surveillance monitoring at Site 300 uses both on-site and off-site wells. Depending on their location and purpose, well waters at Site 300 are sampled monthly, quarterly, or annually and are analyzed for gross radioactivity, certain radioisotopes, and a wide range of nonradioactive inorganic and organic chemicals.

Surveillance Monitoring of the Livermore Valley

Rain and storm water runoff in the Livermore Valley recharge local aquifers. Rain and runoff contain small amounts of tritium from natural sources, from past atmospheric nuclear weapon tests, and from atmospheric emissions from LLNL and Sandia National Laboratories, California (see Chapter 4 on Air Monitoring for further discussion on air emissions). During 1994, approximately 8% of the sewage water treated at the City of Livermore Water Reclamation Plant (LWRP), amounting to 558 million liters (147 million gallons), was used to irrigate nearby municipal land, including a public golf course. This reclaimed water contained low levels of tritium from natural sources and from permitted operational releases to the sanitary sewer system by LLNL and Sandia, California (total radionuclides in liquid effluents are limited to 3.7×10^{10} Bq [1 Ci] per year; see Chapter 5 for details of sanitary sewer releases).

LLNL is located near the eastern end of the Livermore Valley. The valley floor slopes westward, which directs surface stream flow and ground water flow generally to the west from LLNL. Since 1977, annual tritium measurements have been made on water samples collected from monitoring wells and drinking water wells that are hydrologically downgradient from LLNL to determine the impact of tritium migration into the ground from rain, from the LWRP irrigation water, and from storm water runoff that flows through the Arroyo Las Positas and recharges local aquifers (**Figure 7-1**).

Figure 7-1 shows the locations of 21 ground water wells in the Livermore Valley that were sampled and analyzed for tritium during the third quarter of 1994. The wells are all downgradient to the west of LLNL and are located within the Alameda County Zone 7 Flood Control and Water Conservation District. Ten of the wells monitor ground water beneath municipal land near the LWRP, where reclaimed water is used for irrigation. Five drinking water-supply wells serving the City of Livermore were sampled, and six serving the City of Pleasanton were sampled.

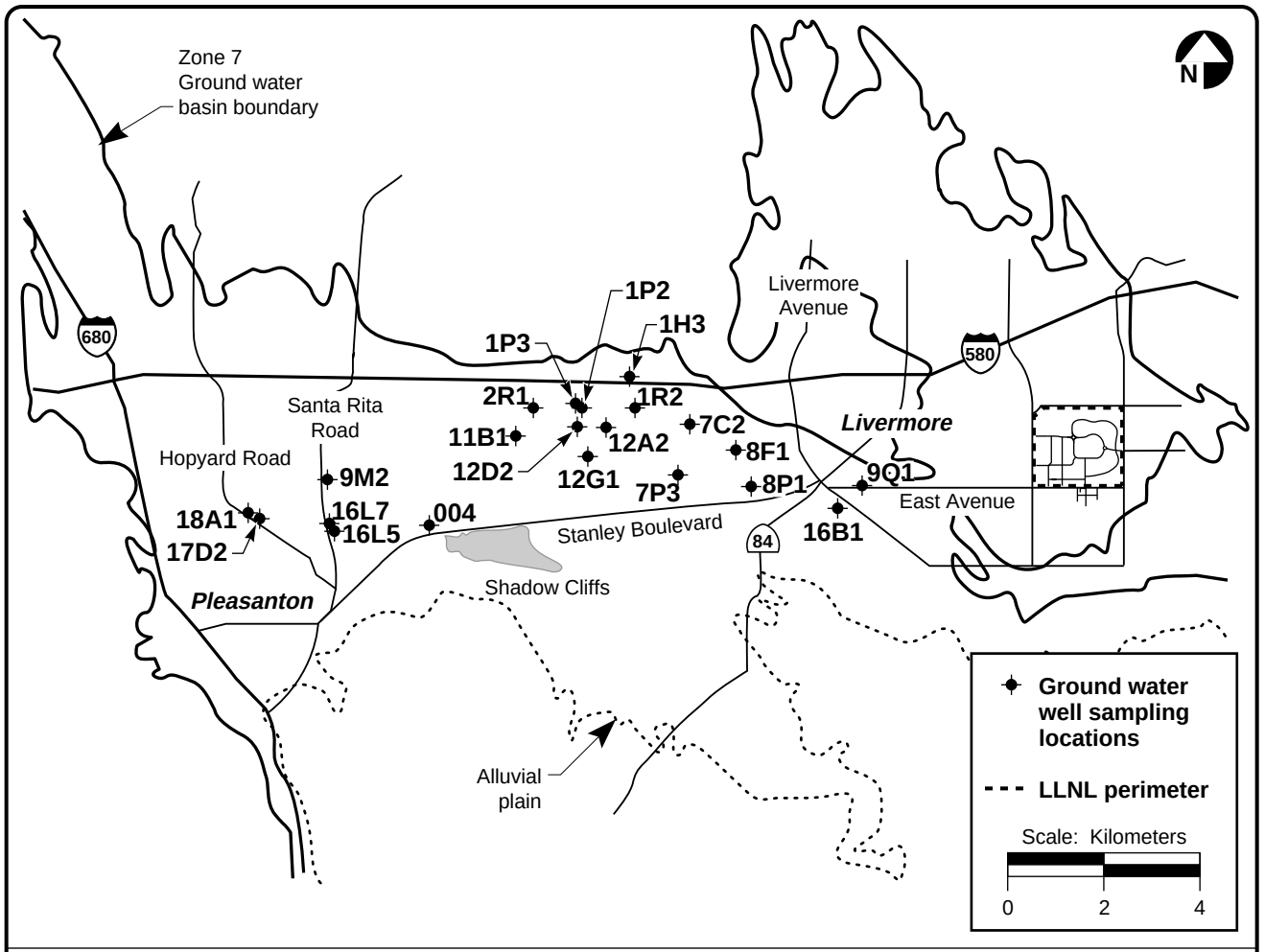

Figure 7-1. Ground water surveillance well sampling locations, Livermore Valley, 1994.

Compliance Ground Water Monitoring at Site 300

The LLNL Experimental Test Site, known as Site 300, is located in the Altamont Hills approximately 15 kilometers southwest of the city of Tracy. Compliance ground water monitoring at Site 300 is governed by WDR Order Nos. 85-188 and No. 93-100 (Central Valley RWQCB 1985; 1993) and a RCRA post-closure monitoring plan (Rogers / Pacific Corporation 1990). Compliance monitoring involves analyses of water samples drawn from 23 wells associated with two closed landfills and two active process water impoundments. **Figure 7-2** shows the closed landfills (pits), the two process water surface impoundments, and all of the on-site and off-site surveillance wells. A brief description of these areas and associated wells follows. A more complete description of the stratigraphy and hydrogeologic conditions at Site 300 can be found in the *Final Site-Wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300* (Webster-Scholten 1994), hereafter referred to as the Final SWRI report.

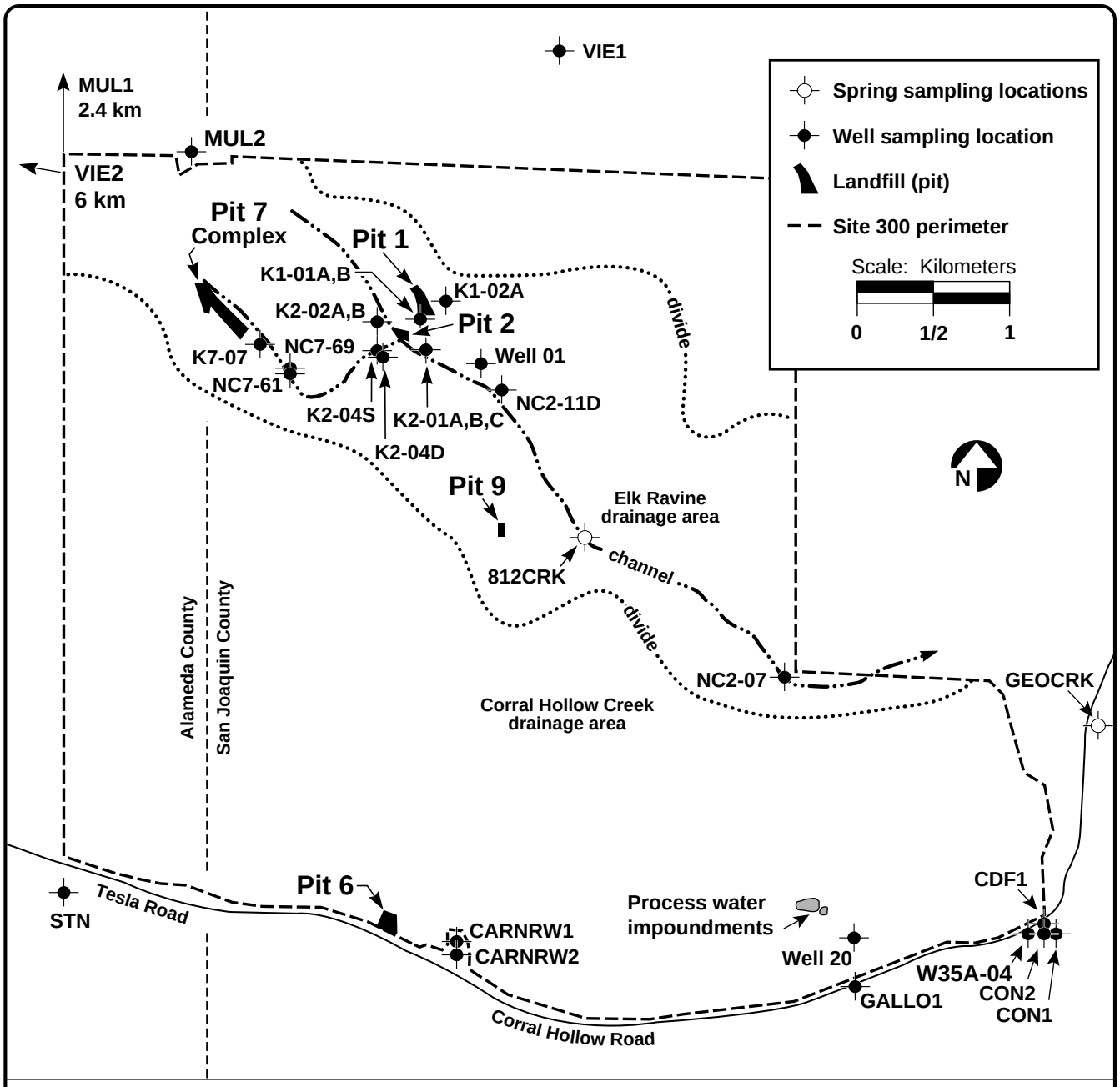

Figure 7-2. Site 300 surveillance wells, springs, impoundments, and closed landfills (pits).

Pit 1 Area

Figure 7-3 shows the locations of Pit 1, the monitoring wells, an adjacent inactive landfill identified as Pit 2, and the Advanced Test Accelerator (ATA) in Building 865. Pit 1 lies in the upper part of the Elk Ravine drainage area at an elevation of 330 meters above sea level. Although the test site is in a semiarid locale, intense rainfall does occur. In order to combat erosion, rain runoff from the pit cap and surrounding area is collected in a concrete channel that encircles

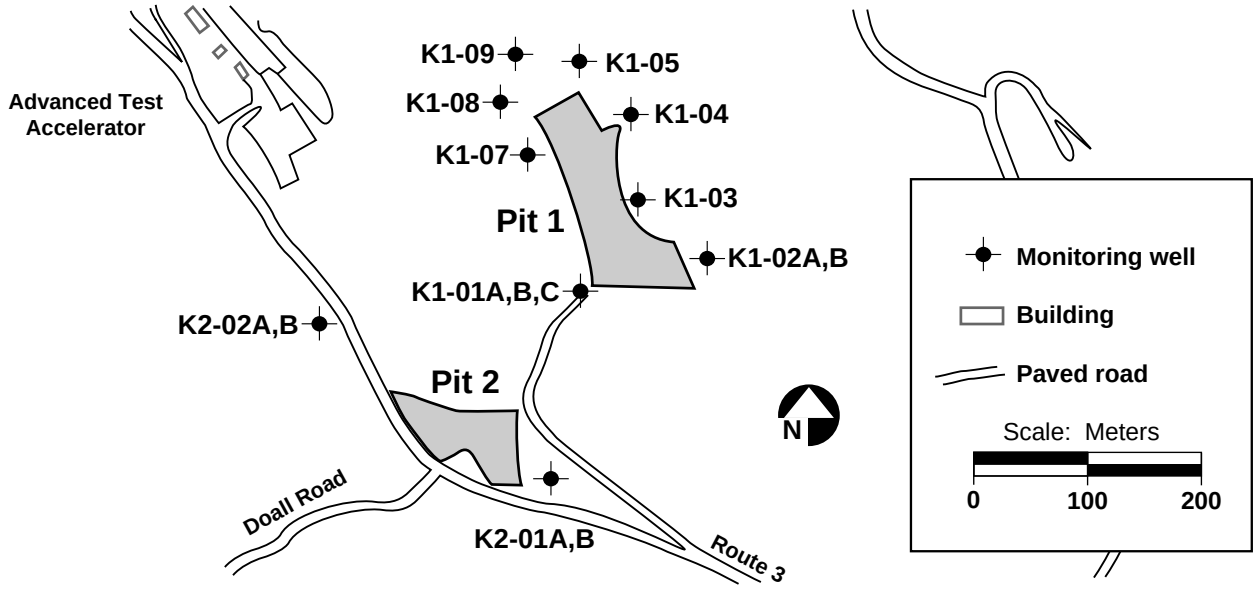

Figure 7-3. Pit 1 compliance wells and Pit 2 surveillance wells.

the pit. The outfall is at the southwest corner of Pit 1 where surface runoff flows to Elk Ravine. Subsurface water flow beneath Pit 1 is east-northeasterly and generally follows the dip of the underlying sedimentary rocks. Compliance monitoring Wells K1-01C and K1-07 are hydrologically upgradient from Pit 1; K1-02B, K1-03, K1-04, and K1-05 are downgradient; and K1-08 and K1-09 are cross-gradient. Pit 2 is hydrologically upgradient from Pit 1 with respect to subsurface water flow, although it is downslope from Pit 1 with respect to rain runoff into Elk Ravine. The ATA is upgradient from Pit 1 monitoring wells K1-05, K1-08, and K1-09.

The Pit 1 monitoring wells are completed near or at the contact between the Tertiary Neroly Formation lower blue sandstone member and the underlying mid-Miocene Cierbo Formation consisting of claystones and siltstones. The Tertiary Neroly and Cierbo sedimentary rock formations contain the main water-bearing strata beneath the test site.

Pit 1 ground water samples were analyzed for constituents fulfilling the requirements of WDR Order No. 93-100 and a post-RCRA-closure monitoring plan (Rogers / Pacific Corporation 1990). Measurements were performed for water table elevation; total dissolved solids (TDS); specific conductance; temperature; pH; metals; high-explosive compounds [cyclotetramethyltetramine (HMX), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and trinitrotoluene (TNT)]; general minerals; total organic carbon (TOC); total organic halides (TOX); radioactivity (gross alpha and gross beta); the radioisotopes tritium (^{3}H), radium (^{226}Ra), uranium (^{234}U, ^{235}U, and ^{238}U), and thorium (^{228}Th and ^{232}Th);

herbicides and pesticides (EPA Methods 615 and 608); purgeable organic compounds (EPA Method 624); and extractable organic compounds (EPA Method 625). See Table 7-4, Volume 2, for the list of analyses for Pit 1 required by WDR Order No. 93-100. See Tables 7-1 and 7-2, Volume 2, for a complete list of methods used, analytes measured, and reporting limits.

Pit 7 Complex Area

Nine wells monitor the Pit 7 Complex that consists of three inactive landfills (Pits 3, 4, and 5), and one RCRA-closed landfill (Pit 7; **Figure 7-4**). The complex of closed landfills lies in the uppermost reaches of the Elk Ravine drainage area at an elevation of 425 meters. To combat erosion and to reduce local recharge, rain runoff from the Pit 7 cap is collected in several concrete channels. Pit 7 is nearly encircled by a concrete channel that collects rain runoff from the pit cap and directs it southeasterly into the Elk Ravine drainage system. A second concrete channel was constructed on the west side of Pit 7. Runoff entering this northerly directed diversion channel is sheet flow that develops on the hill slope immediately to the west of the Pit 7 landfill. Subsurface water can flow in two directions through this area. With sufficient seasonal rainfall, a shallow, unconfined, southeastward flow can develop in the unconsolidated surficial Quaternary alluvial deposits. The predominant ground water flow, however, is east-northeasterly within the underlying Tertiary sedimentary rocks of the Neroly and Cierbo formations that dip east-northeast in this area. With respect to Pit 7 and the predominant flow direction, Well K7-06 is upgradient, Wells K7-09 and K7-10 are cross-gradient, and Wells K7-01, K7-03, NC7-25, NC7-26, NC7-47, and NC7-48 are downgradient. Wells K7-01, K7-10, and NC7-26 are completed in the lower blue sandstone of the Tertiary Neroly Formation that underlies much of the Pit 7 Complex. The remaining wells are completed at the base of, or below, the Neroly and within the claystone and sandstone mid-Miocene Cierbo Formation.

Pit 7 ground water samples were analyzed for constituents fulfilling the requirements of WDR Order No. 93-100 and the monitoring plan for the post-RCRA closure. Measurements were performed for water table elevation; TDS; specific conductance; temperature; pH; metals; general minerals; the radioisotopes tritium (^{3}H), radium (^{226}Ra), uranium (^{234}U, ^{235}U, and ^{238}U), and thorium (^{228}Th and ^{232}Th); high-explosive compounds (HMX, RDX, and TNT); and a wide range of organic chemicals.

High Explosives Process Area

Figure 7-5 shows the portion of the High Explosives (HE) Process Area that includes two process-water impoundments, five compliance monitoring wells, and Buildings 815 and 817. Compliance monitoring of the two impoundments is specified in permit WDR Order No. 85-188, issued by the Central Valley RWQCB (1985). Beneath both process water impoundments in **Figure 7-5** are systems

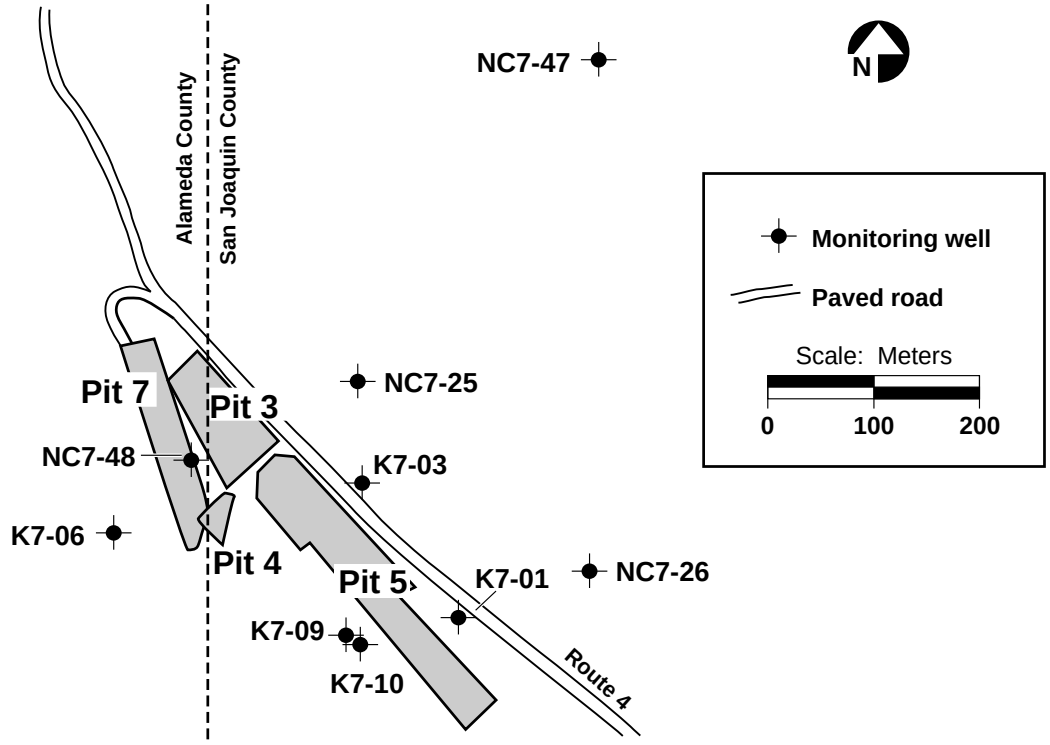

Figure 7-4. Pit 7 Complex compliance wells.

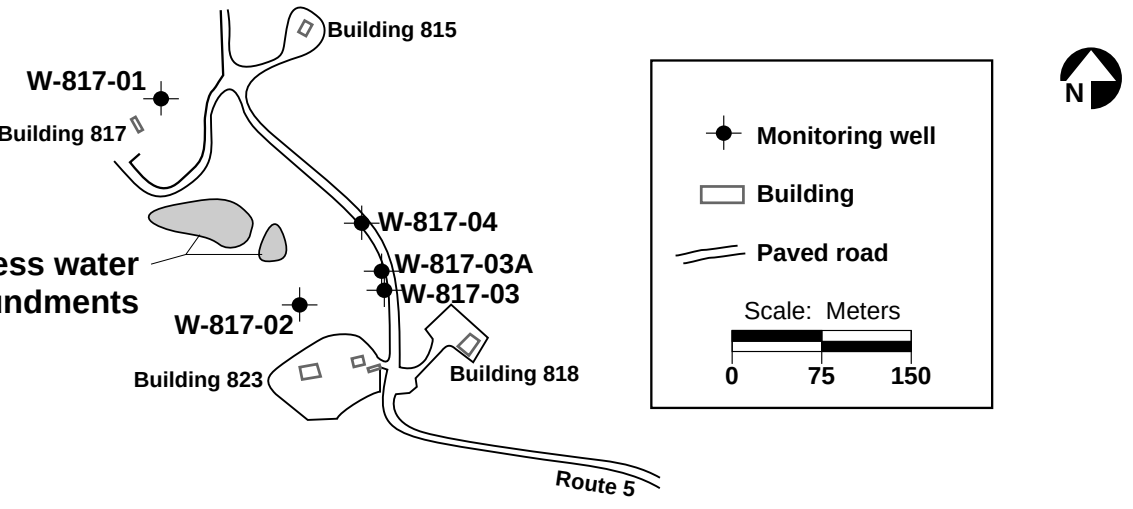

Figure 7-5. HE Process Area compliance wells.

of perforated pipes. The primary purpose of the pipes is leak detection. In addition to the leak detection system, four compliance monitoring wells are completed in the underlying Neroly upper blue sandstone, a water-bearing formation. A fifth compliance monitoring well, W-817-03A, is completed at shallow depth in a nonmarine formation, consisting of unconsolidated sediments and sedimentary rocks, that locally overlies the Neroly Formation. The overlying formation contains a perched water-bearing zone that is very restricted laterally and vertically. The direction of water flow in both formations is approximately southeasterly. Well W-817-01 is an upgradient well with respect to the impoundments. Wells W-817-02, -03, -03A, and -04 are downgradient wells.

Ground water samples were collected quarterly during 1994 from the five compliance monitoring wells in the B-817 HE Process Area. Samples from the four deeper wells completed in the Neroly upper blue sandstone formation were analyzed for metals, general minerals, TOC, TOX, pH, specific conductance, high-explosive compounds (HMX, RDX, and TNT), volatile organic compounds (VOCs), and tritium. Samples from the shallow well W-817-03A were analyzed for VOCs, high-explosive compounds, and tritium.

Surveillance Ground Water Monitoring at Site 300

Thirty-five ground water wells and several springs are monitored at Site 300 as part of the ground water surveillance program (**Figure 7-2**). Twenty-three wells are on site and 12 are off site. One spring, designated GEOCRK, is located off site in the Corral Hollow Creek arroyo. Methods of sampling and analysis are the same for compliance and surveillance monitoring wells, but the constituents of concern and the frequency of sampling may differ. Three of the 12 off-site surveillance wells are located north of Site 300, where the Altamont Hills slope down to the San Joaquin Valley. One well, designated VIE2, is located in the Altamont Hills approximately 6 kilometers west of Site 300 in the upper reaches of the Livermore Valley watershed. The remaining eight off-site surveillance wells are located adjacent to Site 300 on the south in the Corral Hollow Creek drainage area. Twelve of the 23 on-site surveillance wells monitor three inactive landfills (closed pits). Six wells monitor Pit 6 (**Figure 7-6**). Four wells monitor Pit 9 (**Figure 7-7**). Three multiple completion wells monitor Pit 2 (**Figure 7-3**). Nine of the 10 remaining surveillance wells and one spring, designated 812CRK, are strewn along the system of fault-marked ravines and arroyos that comprise the Elk Ravine drainage area (**Figure 7-2**). Well 20 is a production well that provides potable water to Site 300 (**Figure 7-2**). The wells are described below. A more complete description of the stratigraphy and the hydrogeologic conditions can be found in the Final SWRI report (Webster-Scholten 1994).

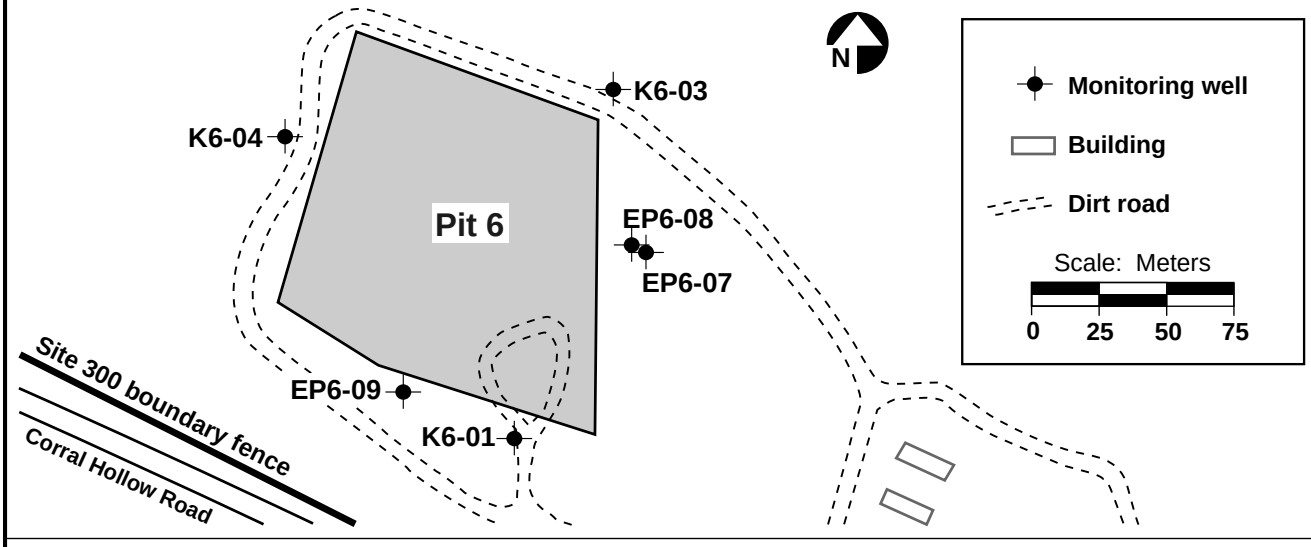

Figure 7-6. Pit 6 surveillance wells.

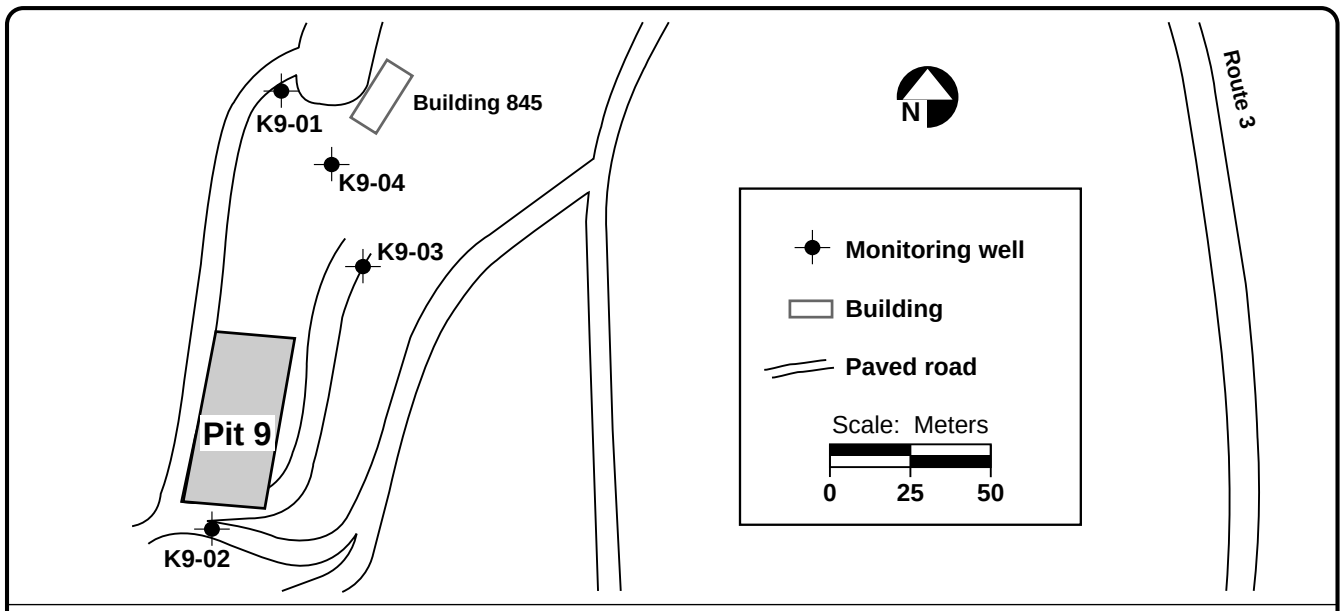

Figure 7-7. Pit 9 surveillance wells.

Pit 2

The inactive Pit 2 landfill lies in the upper portion of Elk Ravine at 320 meters above sea level (**Figure 7-3**). Surface runoff from the pit area is southerly into Elk Ravine. Subsurface water flow beneath the pit is east-northeasterly following the dip of the underlying Neroly and Cierbo sedimentary rocks. Multiple completion Well K1-01, shown in **Figure 7-3**, is completed at three separate depth

intervals in the claystone and sandstone mid-Miocene Cierbo Formation. It contains three Barcad sampling devices. Each Barcad samples a discrete water-bearing zone within the Cierbo Formation. The deepest of the three zones is sampled by Barcad K1-01A, the intermediate zone by Barcad K1-01B, and the upper zone, which is an upgradient monitoring point for Pit 1, by Barcad K1-01C. Surveillance monitoring Wells K2-01 and K2-02 are hydrologically cross-gradient from Pit 2. These are also multiple completion wells and are fitted with Barcad sampling devices. Barcads K2-01A, K2-02A, and K2-02B are completed in the Cierbo Formation. Barcad K2-01B is completed in the lower blue sandstone of the Tertiary Neroly Formation that overlies the Cierbo Formation.

Samples from the Barcad-fitted multiple completions were taken quarterly during 1994 and were analyzed for various metals; radioactivity (gross alpha and gross beta); and the radioisotopes tritium (^{3}H), radium (^{226}Ra), and uranium (^{234}U, ^{235}U, and ^{238}U).

Pit 9

Inactive landfill Pit 9 is centrally located within Site 300 at an elevation of 340 meters above sea level. Surface runoff from Pit 9 flows northeastward into Elk Ravine. Subsurface ground water flow is also east-northeasterly in the lower blue sandstone of the Neroly Formation. Surveillance monitoring Well K9-02 is hydrologically upgradient from Pit 9. Wells K9-01, K9-03, and K9-04 are downgradient. Well K9-02 is completed and screened in the Neroly lower blue sandstone at its contact with the underlying Cierbo Formation. Wells K9-01, K9-03, and K9-04 are completed and screened in the Cierbo Formation, just below its contact with the Neroly Formation.

Pit 9 surveillance monitoring Wells K9-01, K9-02, and K9-03 were sampled and analyzed once during 1994 for general contaminant indicator parameters, general minerals, metals, radioactivity, radioisotopes, and a wide range of organic compounds, including pesticides and herbicides. Because Well K9-04 contained little water, it was analyzed only for uranium isotopes.

Elk Ravine Drainage Area

The Elk Ravine drainage area includes most of northern Site 300, the area between the drainage divides shown on **Figure 7-2**. This semiarid area collects rare surface runoff into arroyos from inactive landfill Pits 1, 2, 3, 4, 5, 7, 8, and 9. Surface runoff from the Pit 7 Complex area flows southeastward to Doall Road, where it is deflected northeastward into Doall Ravine by a landslide deposit. At the northeastern end of Doall Ravine, the runoff combines with channeled runoff from the ATA area. From this confluence point, the arroyo trends southeasterly within Elk Ravine. Near Well NC2-07, channeled runoff turns easterly away from the trend of the Elk Ravine fault and flows off site for approximately

2 kilometers to its confluence with Corral Hollow Creek. Except for Doall Ravine, the arroyos traverse and follow faults, especially the extensive Elk Ravine Fault that may provide conduits to the underlying water-bearing Neroly strata. For this reason, ground waters from wells that lie within this drainage network are monitored. The monitored wells are (from highest to lowest elevation within the drainage area) K7-07, NC7-61, NC7-69, K2-04D, K2-04S, K2-01C, NC2-12D (replaced Well 01), NC2-11D, and NC2-07. The 812CRK sampling location is a natural spring, also known as Spring 6. It is located in the main Elk Ravine arroyo on the Elk Ravine Fault. Individual wells are discussed below.

Well K7-07 is a shallow well, completed and screened in the upper Neroly lower blue sandstone and the overlying Quaternary alluvium. The well was dry during 1994. Wells NC7-61 and NC7-69 are completed and screened in and sample separate water-bearing zones beneath the upper reach of Doall Ravine, downstream from Well K7-07. Well NC7-61 is completed and screened in the shallower Neroly Formation lower blue sandstone, and Well NC7-69 is completed and screened in the deeper Cierbo Formation. Wells K2-04D and K2-04S and Barcad K2-01C are located near the join between Elk Ravine and Doall Ravine. They are all completed and screened in the upper Neroly Formation lower blue sandstone. Wells NC2-12D and NC2-11D are located in Elk Ravine below its join with Doall Ravine. Well 01, originally a drinking water well and then an emergency fire-suppression well, was completed and screened in the Neroly Formation lower blue sandstone. Well 01 was properly sealed and abandoned in 1994 after third-quarter samples were taken. An adjacent well, NC2-12D, replaced Well 01 for surveillance purposes and was sampled during the fourth-quarter of 1994. Well NC2-11D is completed at the boundary between the Cierbo and the overlying Neroly formations. The farthest downstream on-site well in the Elk Ravine drainage area is Well NC2-07. It is completed in the Neroly Formation lower blue sandstone.

Ground water samples from all wells were analyzed for various metals, including beryllium, radioactivity (gross alpha and gross beta), tritium, and VOCs (EPA Method 601). Due to limited sample water for analysis, Well NC2-07 was not analyzed for metals. Samples from Wells NC7-61 and NC7-69 were additionally analyzed for uranium isotopes (^{234}U, ^{235}U, and ^{238}U). Samples from Wells K2-04D, K2-04S, and K2-01C were additionally analyzed for nitrogen compounds. The Spring 812CRK samples were analyzed for metals, gross alpha, gross beta, and tritium.

Pit 6

The closed Pit 6 landfill is positioned along the southern boundary of Site 300 at an elevation of 210 meters above sea level (**Figure 7-2**). It lies in Quaternary terrace deposits above and north of the Corral Hollow Creek floodplain. The Tertiary Neroly Formation sedimentary rocks underlie the terrace deposits. Surface runoff from the pit area is southward to Corral Hollow Creek. Ground water flow beneath the pit is also southward, following the south-dipping sedimentary rocks of the Neroly Formation. However, the direction of the subsurface flow changes from south to southeast beneath the southern margin of the landfill where the Carnegie Fault has brought vertically dipping strata on the south into contact with gently dipping strata on the north. A deposit of terrace gravel fills a southeasterly trending trough within the vertically dipping strata immediately south of the landfill and acts as a channel for the ground water after it passes beneath Pit 6.

Six wells comprise the surveillance monitoring network at closed landfill Pit 6 (**Figure 7-7**). Well K6-03 is hydrologically upgradient from Pit 6 and is completed and screened in the gently southward dipping Tertiary Neroly sedimentary rocks. Wells K6-04, EP6-07, and EP6-08 are hydrologically cross-gradient from Pit 6 and are also completed and screened in the south-dipping Neroly sedimentary rocks. The completion interval of Well K6-04 extends upwards into the Quaternary terrace deposits. Wells EP6-09 and K6-01 are hydrologically downgradient from Pit 6 and are completed and screened in the vertically dipping Tertiary sedimentary rocks.

Ground water samples from the Pit 6 surveillance wells were analyzed for metals; general minerals; organic compounds, including VOCs (EPA Method 601), herbicides (EPA Method 615), and pesticides (EPA Method 608); the general contamination indicator parameters pH, specific conductivity, TOC, and TOX; radioactivity (gross alpha and gross beta); and the radioisotopes tritium (^{3}H), radium (^{226}Ra), and uranium (^{234}U, ^{235}U, and ^{238}U).

Well 20

This well supplied potable water at Site 300 during 1994. It is a deep, high-production well that is completed in the Tertiary Neroly Formation lower blue sandstone. The well can produce up to 1,500 liters of water per minute. Additional geologic and hydrogeologic information regarding Well 20 is contained in the Final SWRI report (Webster-Scholten 1994). Quarterly samples taken from this drinking water production well during 1994 were analyzed for the metals beryllium, chromium, copper, and lead; for gross alpha and gross beta radioactivity; and for tritium. Monthly well samples were also taken and analyzed for VOCs using EPA Method 502.2 or 524.2.

Off-Site Supply Wells

Twelve off-site potable water-supply wells near Site 300 were tested during 1994 as part of the Site 300 surveillance monitoring program. Four wells—MUL1, MUL2, VIE1, and VIE2—lie to the north of Site 300. Wells CARNRW1, CARNRW2, CDF1, CON1, CON2, GALLO1 STN, and W-35A-04 are located to the south of the test site (**Figure 7-2**).

Six wells were sampled quarterly during 1994. Of these, CARNRW1 and CON2 were tested for VOCs only (EPA Method 601), while CARNRW2, CDF1, CON1, and GALLO1 were tested for a large suite of inorganic and organic compounds. The remaining six wells—MUL1, MUL2, STN, VIE1, VIE2, and W-35A-04—were tested once during 1994 for a large suite of inorganic and organic compounds. All wells, except CARNRW1 and CON2, were tested at least once during 1994 for high-explosive compounds (HMX, RDX, and TNT), radioactivity (gross alpha and gross beta), and tritium.

Results

This section presents the results of measurements in Livermore Valley wells, Site 300 Pit 1 area, Pit 7 Complex area, HE Process Area, Pit 2, Pit 9, Elk Ravine drainage area Pit 6, water-supply Well 20, and off-site supply wells.

Livermore Valley Wells

Tritium measurements of water samples collected once during 1994 from 21 wells in the Livermore Valley are given in the following **Table 7-1**. Tritium in all well samples was very low compared to the 740 Bq/L (20,000 pCi/L) maximum contaminant level (MCL) established for drinking water by the EPA. As in previous years, the highest tritium measured, 15.7 Bq/L (424 pCi/L), was in a water sample from the irrigation monitoring Well 11B1. Tritium in Well 11B1 has decreased 33% since 1991, when it was 23.4 Bq/L (630 pCi/L).

The overall trend of tritium is downward in Livermore Valley ground waters. In 1989, the mean (arithmetic average) well tritium was 5.4 Bq/L (145 pCi/L). By mid-1994, the mean activity had dropped by more than 50% to 2.5 Bq/L (68 pCi/L). The mean well tritium for the past six years is plotted in **Figure 7-8**, together with a plot of total measured annual tritiated water (HTO) emissions to the atmosphere by LLNL and Sandia, California. (Note that in **Figure 7-8** that the tritium per liter in the ground water is about ten trillion times smaller than the annual atmospheric emissions.) Two processes are operating on the tritium in the ground water: natural decay of tritium and mixing of old ground water with younger recharge water. In a closed system, tritium decreases naturally by 50% each half-life of 12.3 years. However, tritium decreased 50% in the Livermore Valley open ground water system in 6 years. The additional decrease, over that expected by decay, is due to dilution of older ground water by younger ground water containing less tritium. Dilution provides the connection between the downward trend in ground water tritium and the downward trend in tritium

emissions shown on **Figure 7-8**. If atmospheric emissions continue to decrease, then tritium in ground waters will also continue to decrease. Tritium in Livermore Valley drinking water is at a very low and safe level, amounting to less than 1% of the MCL.

Table 7-1. Tritium activity in Livermore Valley wells (in Bq/L), 1994.

Well No.	Activity	Percent of MCL
LWRP		
1H3	0.43 ± 0.09	0.06
1P2	3.50 ± 0.20	0.47
1P3	0.57 ± 0.11	0.08
1R2	1.79 ± 0.15	0.24
2R1	3.56 ± 0.17	0.48
7C2	2.68 ± 0.17	0.36
11B1	15.69 ± 0.50	2.12
12A2	3.51 ± 0.17	0.47
12D2	6.22 ± 0.24	0.84
12G1	4.96 ± 0.20	0.67
Mean	**4.29**	**0.58**
Standard deviation	**4.39**	
Livermore		
7P3	0.06 ± 0.06	0.00
8F1	1.25 ± 0.13	0.17
8P1	1.69 ± 0.13	0.23
9Q1	1.14 ± 0.14	0.15
16B1	0.77 ± 0.13	0.10
Mean	**0.98**	**0.13**
Standard deviation	**0.61**	
Pleasanton		
9M2	0.88 ± 0.15	0.12
4	1.14 ± 0.14	0.15
16L5	1.08 ± 0.15	0.15
16L7	1.62 ± 0.17	0.22
17D2	0.09 ± 0.09	0.01
18A1	0.28 ± 0.13	0.04
Mean	**0.85**	**0.11**
Standard deviation	**0.57**	

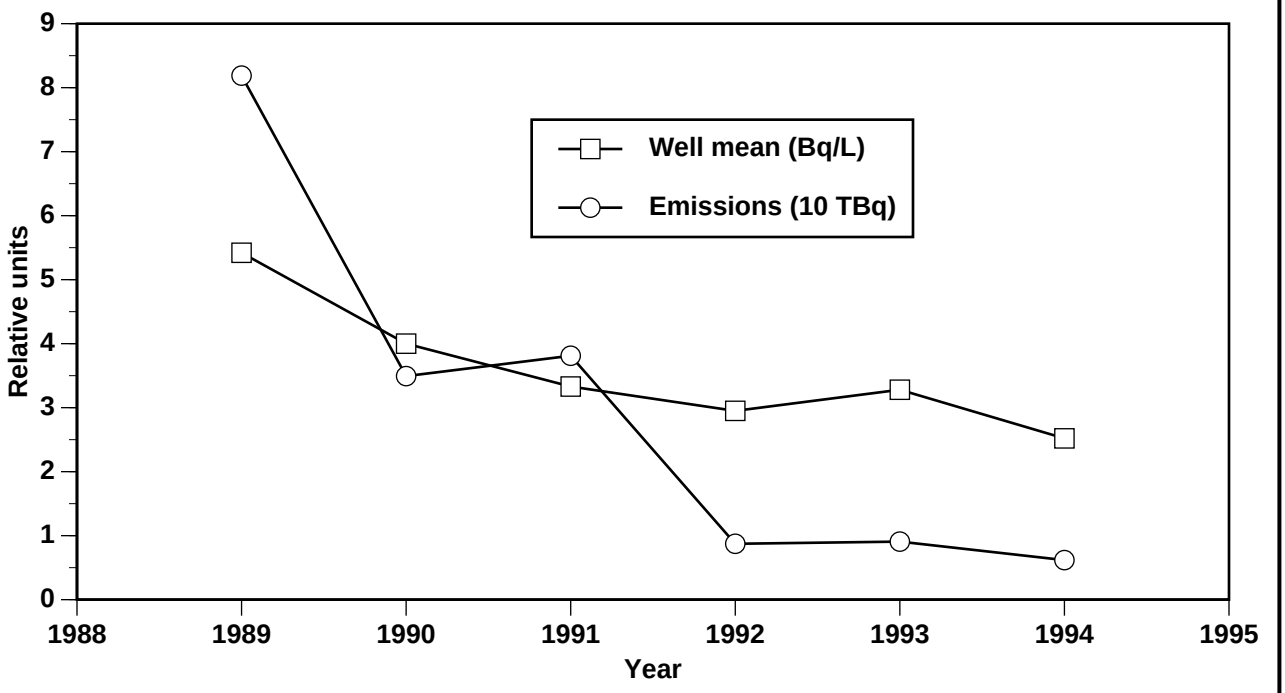

Figure 7-8. Trends of tritium in Livermore Valley wells and atmospheric emissions, 1989 to 1994.

Site 300 Pit 1 Area

In compliance with the reporting requirements under WDR Order No. 93-100, LLNL notified the Central Valley RWQCB of "statistically significant evidence of a release" of arsenic and total dissolved solids (TDS) from Pit 1. In addition to arsenic, samples from Pit 1 downgradient monitoring Well K1-02B contained significantly more TDS than did the upgradient wells. Measurements of arsenic in Pit 1 ground water samples made during 1994 exceeded the 0.02 mg/L concentration limit for arsenic specified in WDR Order No. 93-100 (see Table 7-4, Volume 2). [Note: the concentration limit is a statistically determined number that is equal to the average background (upgradient) concentration plus approximately three standard deviations. It is not related to the 0.05 mg/L MCL for arsenic established for drinking water by the EPA.]

Additional analyses and measurements indicate that no releases of chemicals from Pit 1 to ground water occurred during 1994, and it is improbable that Pit 1 has released arsenic to ground water since measurements began in 1987 for the following reasons:

- The arsenic increase of 1994 was observed in both upgradient and downgradient well water samples (Christofferson et al. 1994a, 1994b). A release from the pit could not have produced the observed concentration increase in the upgradient well samples.

- The phenomenon was short lived. Arsenic concentration decreased below the concentration limit in both upgradient and downgradient well samples during the third quarter and showed the same low levels during the fourth quarter of 1994.
- Analysis of variance (ANOVA) of the arsenic data revealed that differences in arsenic concentrations between upgradient and downgradient well water samples were not significant during the period when the concentration limit was exceeded (Christofferson et al. 1994b, 1994c).

Therefore, the varying concentration of arsenic observed during 1994 in the Pit 1 area ground water samples was probably due to natural causes or measurement calibration errors, but not a release of arsenic from Pit 1.

It is also improbable that elevated TDS in water samples taken from Pit 1 Well K1-02B indicates a release of chemicals from Pit 1. The mean concentration of TDS is about 15% higher in water samples from Well K1-02B than in water samples from the remaining Pit 1 monitoring wells. However, the major contributors to TDS are calcium, magnesium, and sulfate; natural constituents that come from sources in the sedimentary rocks along the water flow path. Most likely, the elevated TDS in Well K1-02B samples represents the variability of natural sources of calcium, magnesium, and sulfate within the sedimentary rocks that underlay this area. Well K1-02B water samples contain sufficiently more calcium, magnesium, and sulfate than the other Pit 1 monitoring wells to account for the relatively elevated TDS measurements.

Tritium increased in ground water samples from downgradient monitoring Well K1-02B from 1989 to 1993, when it peaked at 130 Bq/L (3500 pCi/L). The maximum activity measured during 1994 was 123 Bq/L (3325 pCi/L). Pit 1 is not the source of the tritium. Rather, it correlates with a plume of tritium-bearing ground water that is moving slowly into the Pit 1 area from a source about 1 kilometer to the southwest at the Building 850 firing table (Webster-Scholten 1994). The plume primarily contributes tritium to downgradient monitoring Well K1-02B samples, but tritium in samples from the monitoring wells closest to K1-02B, upgradient Well K1-01C and downgradient Well K1-03, both show tritium elevated above background levels (see Table 7-5, Volume 2). Increased tritium in water samples from Well K1-01C is evidence for a tritium source outside of Pit 1.

During 1994, the compound 1,1,2-trichloro-1,2,2-trifluoroethane, known as Freon-113, was detected far below the California State Action Level of 1200 μg/L in ground water samples from Wells K1-05, K1-08, and K1-09. However, Pit 1 has no record of Freon disposal. The Pit 1 wells that yield ground water samples containing this Freon compound are also downgradient from the ATA Building 865 (**Figure 7-3**) where a Freon spill to ground is known to have

occurred. The history of Pit 1 monitoring well measurements shows Freon increasing in Well K1-09 four years before a similar increase was seen in Well K1-05. This delay in Freon reaching the well near Pit 1, K1-05, indicates that the source is outside of Pit 1 in the direction of the ATA.

Gross alpha, gross beta, total uranium, radium, and tritium activities measured in water samples taken from Pit 1 compliance monitoring wells were all low and were indicative of natural background levels.

An impermeable cap was installed over Pit 1 in 1992. The purpose of the cap is to assure that waste material buried in the pit will be contained. Despite some initial data to the contrary, additional measurements and analyses made during 1994 demonstrate that this landfill has not leached detectable concentrations of any chemicals to ground water.

A complete table of measurements conducted on ground water samples taken from Pit 1 compliance monitoring wells during 1994 is presented in Volume 2 (Table 7-5).

Pit 7 Complex Area

The monitoring data for 1994 continue to show tritium from a release to ground water known to have occurred in 1983 from Pit 3 (Webster-Scholten 1994). The release resulted from higher-than-normal rainfall that infiltrated the pit during the 1982–1983 wet season. Although a few measurements made during 1994 constitute statistical evidence of a past release of vanadium from Pit 7 to the ground water, the data generally do not indicate the release of any constituent of concern from Pit 7 since 1992 when an impermeable cap was constructed over the pit. The RCRA cap was designed to prevent the release of any chemicals from the closed Pit 7 landfill due to rain infiltration.

In 1994, through ground water monitoring of the Pit 7 Complex area, LLNL discovered statistical evidence of a release of vanadium from Pit 7. LLNL submitted a 7-day letter report to the Central Valley RWQCB when vanadium was first detected above the 0.05 mg/L CL at 0.06 mg/L in a first quarter 1994 ground water sample from Well NC7-47, the most distant downgradient monitoring well in the network (Christofferson et al. 1994a). Subsequently, vanadium was detected above the concentration limit at 0.12 mg/L in a fourth quarter ground water sample from Well NC7-48, the downgradient monitoring well nearest Pit 7 (Christofferson et al. 1995a).

Vanadium occurs naturally in ground waters at highly variable background concentrations of up to 0.17 mg/L at Site 300 and up to 0.27 mg/L in the Central Valley (Webster-Scholten 1994). The background (upgradient) monitoring well for Pit 7, Well K7-06, is near the ground water recharge area. It taps relatively

fresh ground water that contains less than 0.05 mg/L of vanadium (Table 7-6, Volume 2). The detection of vanadium in water samples from the farthest and nearest downgradient wells, but not from the intermediate-distance monitoring wells, strongly implies that the vanadium in the most distant well samples is from natural sources. The ground water most likely continues to dissolve additional vanadium from the sedimentary rocks along its flow path beneath the Pit 7 Complex area. A progressive increase of vanadium in the ground water from natural sources along the flow path cannot be distinguished from vanadium coming from the landfill; therefore, vanadium cannot be relied on, by itself, to indicate a release from the landfill.

Tritium activities during 1994 continued above the 740 Bq/L MCL in ground water samples from downgradient monitoring Wells K7-01, K7-03, and NC7-25. The highest tritium measured in 1994 was 10,027 Bq/L (271,000 pCi/L) in a third-quarter sample from monitoring Well NC7-25. This activity is about 14 times the MCL. However, none of the wells in this area are used to produce water for human or animal consumption.

Total uranium activity in downgradient monitoring Well NC7-25 exceeded the drinking water MCL of 0.74 Bq/L (20 pCi/L) for the first three quarters of 1994. The highest total uranium activity measured during 1994 was 0.95 Bq/L (26 pCi/L) in a second-quarter sample. This activity is equal to 1.3 times the MCL. A full uranium characterization for the Pit 7 Complex area (including Pits 3 and 5) will be completed during 1995. Initial analytical results give a natural uranium isotopic signature for the uranium in Well NC7-25 samples. The uranium characterization includes ground water sampling and analysis for uranium and uranium isotopes, additional sampling and uranium analysis of soil and rock, fate and transport modeling, and a risk assessment.

A complete table of measurements conducted on ground water samples taken from Pit 7 compliance monitoring wells during 1994 is presented in Table 7-6, Volume 2.

HE Process Area

Leak detection systems, consisting of perforated pipes, are installed between the inner and outer liners of the two Class II process water surface impoundments in the HE Process Area. The systems are installed above an impermeable layer of clay that has been graded to provide optimum capture and removal of any leachate by the perforated pipes should any leak occur in the liners of the evaporation ponds. The pipe outfalls are checked weekly for the presence of any leachate water. No leachate water was observed during 1994. Water has been observed only once in previous years when a seal in the pipe connecting the two evaporation ponds leaked a small amount of leachate.

In addition to the leachate monitoring effort, LLNL is required to conduct quarterly analyses of ground water samples taken from a network of nearby monitoring wells. A complete table of measurements conducted during 1994 on ground water samples taken from the surface impoundment compliance monitoring wells is presented in Table 7-7, Volume 2. Water samples drawn during 1994 from these wells all exhibited levels of arsenic, selenium, and nitrate near or above drinking water MCLs (Webster-Scholten 1994).

The high arsenic and selenium concentrations are natural and result from the dissolution of arsenopyrite and mafic minerals from the volcaniclastic-rich Neroly upper sandstone (Webster-Scholten 1994; Raber and Carpenter 1983). The highest arsenic value measured was 66 μg/L in downgradient Wells W-817-02 and W-817-04. The drinking water MCL for arsenic is 50 μg/L. Background concentrations of arsenic range up to 220 μg/L at Site 300. The highest selenium value measured was 94 μg/L in Well W-817-02. This is nearly twice the EPA 50 μg/L drinking water MCL for selenium. Background concentrations of selenium range up to 13,000 μg/L in the region. The highest nitrate value measured as nitrogen was 25 mg/L in Well W-817-04, which is 2.5 times the EPA drinking water MCL for nitrate measured as nitrogen. The origin of the nitrate is uncertain. Background concentrations of nitrate range up to 20 mg/L (as nitrogen) at Site 300. No drinking water wells are located in this area.

As expected from historical data, trichloroethylene (TCE) continued to be above the MCL of 5 μg/L in ground water samples from the downgradient monitoring Wells W-817-03, W-817-03A, and W-817-04. A sample from shallow Well W-817-03A showed the highest value of 42 μg/L, approximately eight times the 5 μg/L drinking water MCL. The source of the TCE is upgradient of the surface impoundments at Building 815. The levels of TCE measured in samples taken from the HE Process Area compliance monitoring wells are consistent with the map of TCE concentrations described in the Final SWRI report for the HE Process Area (Webster-Scholten 1994). Cis-1,2-dichloroethene was detected at a concentration of 2.7 μg/L in a water sample from Well W-817-03A, below the 6 μg/L MCL for this compound.

The high-explosive compound RDX was observed in all water samples drawn from upgradient Well W-817-01. Obviously, the source of the RDX in upgradient Well W-817-01 cannot be the process water impoundments. The highest RDX value measured during 1994 was 113 μg/L. A maximum concentration limit for RDX has not been set.

Tritium, the single radiological parameter monitored in the Building 817 HE Process Area compliance network wells, was at background levels (1.7 Bq/L) in samples from all five network monitoring wells.

A complete table of measurements conducted on ground water samples taken from HE Process Area compliance monitoring wells during 1994 is presented in Table 7-7, Volume 2.

Pit 2

Of the metals, arsenic, barium, iron, lead, and selenium were measured above detection limits. The highest arsenic value was 0.068 mg/L in a sample from Barcad K2-02A. This value is 1.4 times the drinking water MCL for arsenic. The highest barium value was 0.053 mg/L in a sample from Barcad K1-01B and is 5% of the drinking water MCL for barium. Iron was detected in a sample from Barcad K2-02B. The value, 0.14 mg/L, is 50% of the secondary (esthetic) drinking water MCL for iron. No primary MCL for iron has been established. The highest lead value was 0.0037 mg/L in a sample from Barcad K2-01B, which is 7% of the drinking water MCL for lead. The highest selenium value was 0.0046 mg/L in a sample from Barcad K1-01A, which is 9% of the drinking water MCL for selenium. The metal levels are all within the range of natural background concentrations found in the ground water at Site 300 (Webster-Scholten 1994).

The radioactivity and radioisotope measurements show only low background levels for gross alpha, gross beta, radium, tritium, and uranium isotopes. However, although tritium activities in samples from Barcad K2-01B are very low, they are approximately three times the activities measured in samples taken from the other six Barcads in this area. This relatively elevated activity probably defines the boundary of the plume of tritium-bearing water flowing into the Pit 2 area from a source 1 kilometer to the west near Building 850 in the West Firing Area (Webster-Scholten 1994). The incursion of this tritium-bearing water into the Pit 2 and Pit 1 area is also seen in Pit 1 Barcad K1-02B ground water samples (Table 7-5, Volume 2,). The plume appears to be confined to the lower blue sandstone within the Neroly Formation in the vicinity of Pit 2 and Pit 1.

The results of analyses made on ground water samples from seven Pit 2 surveillance monitoring wells during 1994 are given in Table 7-8, Volume 2.

Pit 9

The Well K9-04 sample was analyzed only for uranium isotopes. All of the organic compounds for which LLNL performed an analysis were below reporting limits. All metals, general minerals, and radioisotope measurements were indistinguishable from normal background levels. None of the measurements indicates that Pit 9 released any chemicals to the ground water during

1994. The results of analyses made on ground water samples from Pit 9 surveillance monitoring wells during 1994 are given in Table 7-9, Volume 2.

Elk Ravine Drainage Area

Routine ground water monitoring in the Elk Ravine drainage area included analyses of samples from the wells listed below. Detailed analyses on ground water samples from the Elk Ravine drainage area surveillance monitoring wells during 1994 are given in Table 7-10, Volume 2.

Well K7-07

Well K7-07 was dry during 1994. No water could be obtained for analysis.

Wells NC7-61 and NC7-69

All analyses for beryllium, chromium, copper, and lead in samples from these two wells resulted in no detections. No VOCs (EPA Method 601) were detected in either well.

Of the radioactivity and radioisotope measurements, only Well NC7-61 samples showed elevated tritium. The mean of four quarterly tritium measurements, 7560 Bq/L (204,000 pCi/L), is about 10 times the drinking water MCL for tritium. This tritium-bearing water in the Neroly lower blue sandstone comes from the West Firing Area near Building 850 and is described in the Final SWRI report (Webster-Scholten 1994). Tritium in the underlying Cierbo Formation was very low. The marked difference in tritium between these two wells suggests that the two water-bearing zones are not interconnected in this area.

Wells K2-04D, K2-04S, and K2-01C

As in past years, gross alpha measurements in Barcad K2-01C exceeded the 0.555 Bq/L (15 pCi/L) drinking water MCL. Uranium isotopic measurements made on water samples from Well K2-01C show that the elevated alpha activity results from natural uranium in the ground water.

Elevated tritium was measured in all three wells. The tritium level in Well K2-04D was approximately equal to half the drinking water MCL; the level in Well K2-04S was approximately equal to the MCL; and the level in Well K2-01C was approximately one-fourth the 740 Bq/L (20,000 pCi/L) MCL. These wells lie within the plume of tritium-bearing ground water in the Neroly lower blue sandstone that extends beneath Doall Ravine to Elk Ravine and Pit 1. The source of the plume is near Building 850 in the West Firing Area (Webster-Scholten 1994).

Nitrate measurements in water samples from Wells K2-04D and K2-04S exceeded the drinking water MCL for nitrate by 50%. Elevated nitrate levels are

common in Site 300 ground waters, including the previously discussed HE Process Area, but their origin is still uncertain.

Wells 01, NC2-12D, and NC2-11D

Metals and VOCs (EPA Method 601) were not detected in samples taken from these three wells. Both gross alpha and gross beta radioactivity measurements were far below drinking water MCLs. Only tritium was elevated in the samples from these wells. When it was closed in late 1994, tritium in Well 01 samples had increased to 295 Bq/L (7,970 pCi/L) from 222 Bq/L (6,000 pCi/L) in 1992. Tritium in a fourth quarter 1994 sample from Well NC2-12D was 142 Bq/L (3,830 pCi/L). Tritium increased in Well NC2-11D from 68.6 Bq/L (1,850 pCi/L) in 1992 to a mean of 87.7 Bq/L (2,370 pCi/L) in 1994. These wells are located within the plume of tritium-bearing ground water that is moving slowly southeastward in the Neroly Formation beneath Elk Ravine.

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There were no detections of the four metals in all samples from this spring in the Elk Ravine arroyo. Measurements for gross alpha, gross beta, and tritium were all low and were indistinguishable from background levels at Site 300.

Well NC2-07

No organic constituents of concern were detected in the samples taken in 1994. Gross alpha and gross beta measurements were low and cannot be distinguished from background levels in the Neroly Formation. Tritium measurements were also very low. This well presently lies downgradient from the slowly moving plume of tritium-bearing ground water, discussed above.

Pit 6

Of the metals analyzed in Pit 6 well samples, arsenic, barium, manganese, and selenium were detected at concentrations consistent with natural levels in the area ground water (Webster-Scholten 1994). Two rare detections of beryllium at extremely low levels in samples from Wells K6-01 and K6-03 were followed by no detections in scheduled samples taken six months later.

Of all the organic compounds analyzed for, only the solvent TCE was detected in one monitoring well. The MCL for TCE in drinking water is 5 μg/L. The highest value measured was 9 μg/L in a ground water sample from Well EP6-09. The TCE concentration is down sharply from a high of 18 μg/L measured in 1993. Well EP6-09 lies within a shallow, elongated plume of water that is known

to contain TCE. The plume extends only 100 meters east of Pit 6. The extent of TCE in the Pit 6 area is fully described in the Final SWRI report (Webster-Scholten 1994).

All of the radioactivity and radioisotope measurements of ground water samples from the Pit 6 area wells in 1994 were at low levels that are indistinguishable from natural background levels. No measurement was above the EPA drinking water MCL. The results of analyses made on ground water samples from Pit 6 surveillance monitoring wells during 1994 are given in Table 7-11, Volume 2.

Water-Supply Well 20

No metals of concern were detected in Well 20 water samples during 1994. Radioactivity and tritium measurements of these samples in 1994 gave very low values that are indistinguishable from natural background levels. The results of analyses made on ground water samples from Well 20 during 1994 are given in Table 7-12, Volume 2.

On one occasion during 1994, the solvent 1,2-dichloroethane (1,2-DCA) was detected in a water sample from Well 20 at a concentration of 2.5 μg/L, equal to five times the State of California MCL of 0.5 μg/L. Further sampling and analysis done by LLNL during early 1994 traced the 1,2-DCA to the hydrochloric acid used to preserve the water sample. After removing this source of contamination, 11 subsequent monthly analyses of water samples using EPA Method 502.2 showed Well 20 samples to be free of 1,2-DCA.

Off-Site Supply Wells

No inorganic compounds were detected above primary MCLs in any of the off-site monitoring wells and only two inorganic compounds, sulfate and manganese, were detected above their secondary (aesthetic) MCLs. Two wells, STN and CON1, exceeded the 250 mg/L EPA secondary drinking water MCL for sulfate. Two wells, CON1 and MUL2, exceeded the secondary MCL of 50 μg/L for manganese. High concentrations of sulfate and manganese occur naturally in ground water in the Altamont Hills (Webster-Scholten 1994).

As in the past, low levels of trihalomethanes were detected in water samples from Well CARNRW2 during 1994. The compounds result from water chlorination. Although the tap used to obtain water samples is upstream from the chlorinating mechanism, some reverse flow probably occurs when the well pump is off.

Trichloroethene was reported near the reporting limit of 0.2 μg/L in five water samples from surveillance Well GALLO1 during 1994. Three similarly low detections were seen in samples from this well during 1993. The GALLO1 well is hydrologically upgradient from identified areas of TCE contamination at Site 300

(Webster-Scholten 1994). The trace of organic solvents in samples from this well more likely comes from an unknown source in the Corral Hollow Creek floodplain not associated with Site 300.

Of all off-site radioactivity measurements conducted during 1994, only one exceeded an MCL. Samples from surveillance Well STN showed gross alpha readings above the 0.555 Bq/L (15 pCi/L) drinking water MCL. Measurements of gross alpha in samples from this well ranged from 0.7 to 1.4 Bq/L (14 to 43 pCi/L). This well is located in the Corral Hollow Creek floodplain and is hydrologically upgradient from Site 300. Using mass spectroscopy methods, LLNL has determined the primary source of the gross alpha activity to be natural uranium (0.9 Bq/L or 24 pCi/L). All radioactivity measurements in samples from the remaining off-site surveillance wells gave very low values that are statistically equivalent to natural background levels in the Site 300 area.

The results of analyses made on ground water samples from off-site surveillance monitoring wells during 1994 are given in Table 7-13, Volume 2. Wells CARNRW1 and CON2 were sampled once in 1993 and analyzed for VOCs only. Because no volatiles were detected, these wells are not listed in Table 7-13, Volume 2.

Environmental Impacts

The environmental impacts in the Livermore Valley and at Site 300 are presented below.

Livermore Valley

Tritium is at a very low and safe level in Livermore Valley drinking water. The highest tritium measured in a sample from a drinking water well serving the City of Livermore during 1994 was 1.7 Bq/L (46 pCi/L; Well 8P1). This activity is only 0.2% of the 740 Bq/L (20,000 pCi/L) drinking water MCL. The highest tritium measured in a sampled drinking water well serving the City of Pleasanton during 1994 was 1.6 Bq/L (44 pCi/L; Well 16L5). We calculated the maximum annual environmental impact of 1.7 Bq/L in terms of effective dose equivalent (EDE) based on an individual who ingested two liters of this water every day and who showered with this water for 15 minutes every day during 1994. The total water ingested was 730 liters during 1994. The total water inhaled while showering during 1994 was 4 liters. Total ingestion equals 1,240 Bq (33,500 pCi), and total inhalation equals 7 Bq (180 pCi). Using the dose conversion factors contained in Appendix B, the EDE for ingested tritium is 0.000022 mSv (0.0022 mrem), and the EDE for tritium inhaled while showering is 0.0000002 mSv (0.00002 mrem). The inhalation dose is a hundred times smaller than the ingested dose, and the ingested dose is negligible, equal to only 0.02% of the EPA standard allowable annual dose of 0.1 mSv (10 mrem).

Site 300

Ground water monitoring at Site 300 and adjacent properties in the Altamont Hills leaves little doubt that the impacts of past and present LLNL activities are minimal on ground water beyond the site boundaries. Except for tritium contamination at the site, which is predicted to disappear naturally by decay (Webster-Scholten 1994), solvent contamination of aquifers beneath the site is roughly comparable to the potential contamination from a typical neighborhood gas station that operated over the same number of years. Several analyses of ground water samples from Pit 1 and Pit 7 monitoring wells became minor issues of compliance during 1994 under WDR Order No. 93-100. However, the particular analytes of concern for Pit 1 correlate either with naturally occurring elements such as arsenic, or with sources outside the pit, such as tritium and Freon. Ground water data from Pit 1 indicate that the RCRA-closed landfill did not release any potential contaminants to the ground water during 1994.

Under the WDR Order No. 93-100 permit, several analyses of vanadium in ground water samples from Pit 7 monitoring wells constituted statistical evidence of noncompliance. Vanadium, like arsenic, also occurs naturally in ground water in the Altamont Hills. None of the Pit 7 Complex monitoring data point to a release of any potential contaminants from Pit 7 to ground water during 1994.

During 1994, tritium activities in three Pit 7 downgradient monitoring wells continued to exceed the U.S. and California drinking water MCL of 740 Bq/L (20,000 pCi/L). Fate and transport modeling of the tritium-bearing ground water plume indicates that the tritium will disappear by decay to a level far below the MCL by the time it reaches the Site 300 boundary (Webster-Scholten 1994). None of the on-site tritium-bearing ground water is used for irrigation or for consumption by animals and people; therefore, it presents no health risk.

Depleted uranium (99.8% ^{238}U) has been detected in ground water samples from several monitoring wells in the vicinity of the Pit 7 Complex. Depleted uranium is less radioactive than naturally occurring uranium. The higher concentration of natural uranium in the ground water at Site 300 had previously masked the presence of the depleted uranium. Apparently, Pits 5 and 7 were sources of depleted uranium before Pit 7 was capped in 1992. A study of uranium at Site 300 will be completed in 1995.

Because concentration limits for several constituents of concern as specified in WDR Order No. 93-100 were exceeded during 1993 and 1994, LLNL established an evaluation monitoring and assessment program for the Pit 7 and Pit 1 areas. LLNL will continue to determine the nature and extent of barium, lead, tritium, uranium isotopes, and vanadium adjacent to Pit 7 and arsenic adjacent to Pit 1 by sampling ground water from additional wells and by conducting additional chemical analyses. This work is being transferred from RCRA compliance to

CERCLA compliance. Monitoring data will be integrated into this effort. If LLNL confirms that hazardous substances are or were released from Pits 1 or 7, LLNL will conduct further fate and transport analysis and a risk assessment. If these assessments indicate that the risks and/or hazards posed by these substances are significant, as defined by CERCLA, corrective actions for the appropriate landfill(s) will be incorporated into the CERCLA process. Results of this work will be transmitted to the CERCLA Remedial Project Managers.

No on-site or off-site drinking water wells were impacted by LLNL activities at Site 300 during 1994. The 1,2-DCA measured in a sample from Well 20 in January 1994, was traced to the hydrochloric acid used to preserve the water sample. The surveillance monitoring data contained in Tables 7-5 through 7-13, Volume 2, demonstrate that the on-site and off-site radiological and non-radiological impacts of LLNL operations at Site 300 were negligible during 1994.